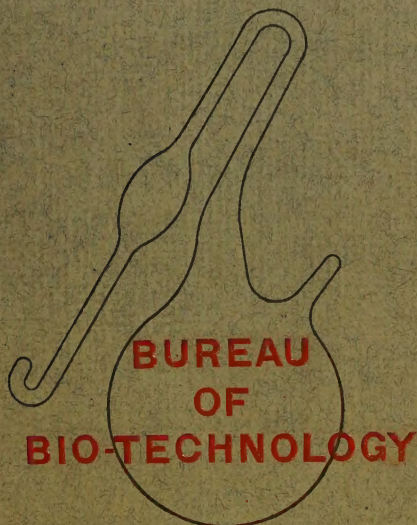

BULLETIN No. 2

JANUARY 1st, 1921



**THE BUREAU OF
BIO-TECHNOLOGY**

□ QUEEN SQUARE. □
□ L E E D S □

THE BIOLOGICAL RESEARCH
:: DEPARTMENT OF ::
MURPHY & SON, LTD.

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FOREWORD

THE encouraging reception accorded to *Bulletin* No. 1, and the unanimity of opinion expressed with regard to the soundness of the aims of the Bureau of Bio-Technology, amply justify the appearance of a second issue.

As foreshadowed in our first "Foreword," we are now able to present to our readers some notes on subjects of a bio-technical character which have recently engaged the attention of the Bureau. It is difficult to select from work so varied as that which falls into the category of Bio-Technology just those matters likely to appeal to the interests of readers occupied in widely different industries, but it is believed that the contents of the present number of the *Bulletin* will prove to be of general technical value.

Comments which have appeared in the technical press of the Milling, Brewing, Textile, Wool, Leather, Agricultural and Horticultural industries have resulted in many enquiries. In addition to letters received from various parts of our own country, correspondence has reached us from Continental sources and even from so far afield as the United States of America. This is a healthy sign that there is a wide-spread interest in the biological aspects of industry, and it emphasizes the fact that the need for investigatory service in Bio-Technology is a very real one.

BUREAU OF BIO-TECHNOLOGY,
LEEDS.

January 1st, 1921.

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The Destruction of Stored Grain by *Trogoderma khapra* Arrow.

A NEW PEST IN GREAT BRITAIN

DURING July of the present year the Bureau had under investigation a serious case of insect depredation in stored malt which occurred in a Midland Brewery. Some hundreds of quarters of grain were involved, and it was at first believed that the damage was the result of weevil infection. It was observed that the malt placed in bins, after leaving the kiln at a temperature of about 180° F. (82° C.), never fell below a temperature of 110° F. (43° C.), even after twelve months' storage, although, under normal conditions, the central portion of the contents of a bin cools down to the temperature of the surrounding atmosphere in two to three months. On opening out the bins it was discovered that the malt was literally alive with small beetles and "grubs," which were intermingled with masses of empty husks; and after removing the bulk of the grain it was apparent from the further large quantities of empty husks, matted together with insect *débris*, which festooned the walls, that destruction representing serious financial loss was taking place. A cursory inspection at once indicated that the

insect responsible was not a weevil, and fuller examination showed that it was not any insect previously associated with the destruction of malt in this country, but was a beetle of Indian origin, *Trogoderma khapra* Arrow.

Only on rare occasions has the occurrence of *T. khapra* been reported in the entomological literature of this country, and so far as we can trace, there is no previous instance of this insect having been found in numbers sufficient to cause appreciable damage. G. J. Arrow, of the Entomological Department of the British Museum, who reported its appearance in cargoes of wheat from Karachi and Bombay in 1917, says, "there is no evidence that it can perpetuate itself in Europe." Nevertheless, we suspected such an occurrence as that to which our attention had been drawn was hardly likely to be an isolated one, and our suspicions have since been amply confirmed by the examination of material from other sources, notably from the Burton district, where there is probably a larger quantity of stored malt than in any other locality in the United Kingdom. There can be little doubt that the presence of this destructive insect is due to infected material contained in shipments of Indian Barleys, which, prior to the War, were imported in large quantities for malting purposes. In one year alone as much as 30,000 quarters of Karachi barley arrived at British Ports and was distributed to maltings and breweries throughout the country. On enquiry it was found that the only Indian Barley ever used in the maltings of the Brewery concerned was introduced about four years ago, and the presence of numerous beetles became noticeable two years later. There is now every indication that this insect, owing to a ready adaptability to new surroundings, has been able, not only to perpetuate its species here, but to develop in such unsuspected proportions as to become a pest of serious economic importance.

Until the year 1916 nothing whatever was known of the life-history of this insect although its association with damaged grain had long been familiar to the Indian natives, who called it "khapra." The annual losses to stored wheat by this and other beetles became so serious, however, as to lead to an investigation of the causes and methods of prevention by J. H. Barnes, Chemist to the Punjab Department of Agriculture, and A. J. Grove, Government Entomologist, whose results, containing the first authentic account of the life-history of "khapra," are embodied in their paper, "The Insects attacking stored Grain in the Punjab," published in "Memoirs of the Department of Agriculture, India," Vol. IV., No. 6 (Chemical Series), 1916.

Unfortunately, some confusion has arisen with regard to the scientific nomenclature of the beetle "khapra." In the work of Barnes and Grove the insect is called *Attagenus undulatus* Motsch, while Lefroy, in his "Indian Insect Pests", refers to it as *Æthriostoma undulata* Motsch. Neither name is correct, "khapra" being *Trogoderma khapra*, which is the name given by G. J. Arrow, who first diagnosed the species in Annals Mag. Nat. Hist., London, Vol. XIX., 1917, and it is important that this insect should not be confused with *Attagenus undulata* Motsch, or with the well-known European *Megatoma undata* L. (syn. *Megatoma undulata* Herbst).

T. khapra belongs to a family of beetles known as *Dermestidæ*, the members of which are widely distributed over both temperate and tropical regions and are exceedingly variable in their habits. Many of the species are pests in one way or another, frequenting and destroying furs, hides, and animal substances in general; food materials, such as cheese, bacon, grain, etc.; cork and other vegetable products. In Fowler's "British Coleoptera," it is recorded that at one time the ravages of an insect belonging to

this family, *Dermestes vulpinus*, in the large skin warehouses in London was of such a costly character "that a reward of £20,000 was offered for an available remedy, without, however, any being discovered." The same insect is also known as a destructive pest in stored tobacco. Most of the species are small, oval, inconspicuous insects, differing but little in general appearance.

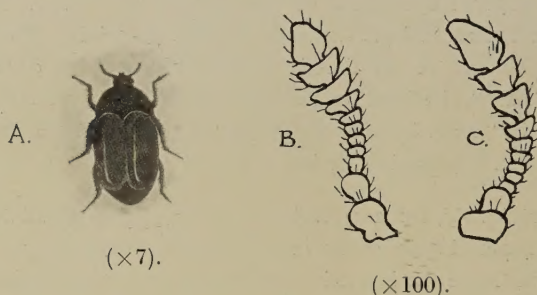


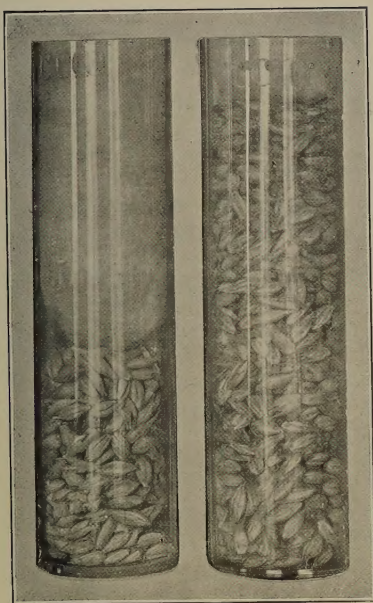
FIG. 2.—*Trogoderma khapra* Arrow.

A—Adult male. B—Antenna of female beetle.

C—Antenna of male beetle.

(After Barnes & Grove.)

T. khapra is a small insect, measuring about 3 mm. in length, broadly oval in shape. The adult insects exhibit marked sex-differentiation in both colour and size. The male beetle is of an almost uniform, dark-brown colour, while the female, which is the larger insect, is distinctly lighter in colour. The antennæ of the two sexes differ, as illustrated in Fig. 2. The surface of the body is covered with minute brown hairs and there is a fringe of darker hairs at the tip of the abdomen; these fine hairs are best seen in newly-emerged specimens as they appear to be easily abraded during the wanderings of the insect through grain and *débris*.

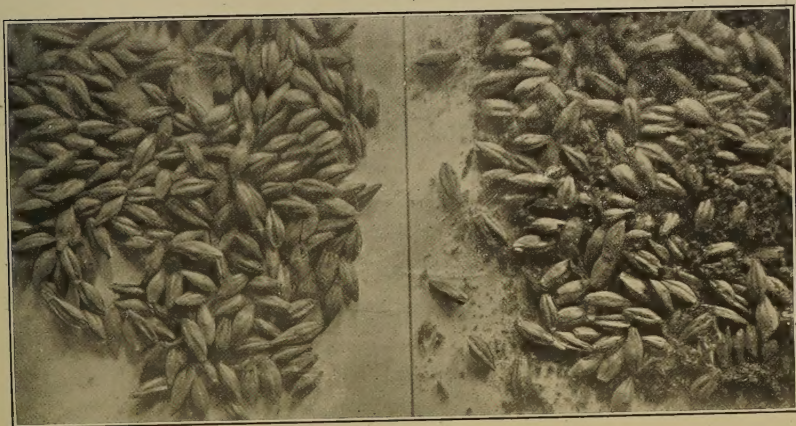


A

B



C



D

Plate 3.

Fig. *A.* 20 grams normal Malt.

Fig. *B.* 20 grams infected Malt.

Fig. *C.* Larva of *T. khapra* ($\times 25$).

Fig. *D.* Appearance of Malt before and after attack by
larvæ of *T. khapra*.

In the adult stage the beetle has not been observed directly attacking malt corns* (although it is frequently found inside the empty husks, as will be accounted for below), nor was it found, in the Indian experiments, to attack wheat. Its life in this stage is short, not usually more than ten days; in the case of the female the insect dies immediately after laying her eggs, which, on the average, are 35 to 40 in number deposited over a period of six to seven days.

The eggs may be deposited in the furrow, or on some other portion of the surface of the grain. After a period of six to seven days they hatch out into larvæ which appear as yellowish-white grubs, covered with hairs of a reddish-brown colour. These hairs are of two kinds—long, simple bristles and shorter barbed hairs—and in the different stages of larval development there is a distinct sequence of variation in the position and proportion of these two kinds of hairs. In the young larvæ, the simple hairs at the posterior end of the body are very long, and project as a brush-like tail, the length of which decreases proportionally as the larvæ develop.

It is during the larval or "grub" stage of the insect's metamorphosis that the ravages to malt and other grain are committed. Immediately on hatching, the grub commences to feed on loose particles of farinaceous matter and the exposed endosperm of broken corns which are always present in grain, afterwards attacking whole corns by boring through the epidermis. The husk is never eaten, the grub feeding exclusively on the internal parts (endosperm, etc.) of the grain.

Larval development is marked by a periodical moulting process (ecdysis) which the grub undergoes, and which, from the

* A grain of barley or malted barley is usually called by a maltster or brewer, a "corn."

commencement to the completion of this stage, occurs some seven or eight times. In all the Indian experiments it was observed that just previous to each ecdysis, the grub leaves the grain upon which it has been feeding and retires to some sheltered position, usually at the bottom of the vessel in which the infected material had been placed, returning to the attack soon after casting its skin. From our own observations with regard to this stage of the insect's life in malt, the grub appears to find the strong husk the best protection during its moulting process, and there is every indication that once inside a corn it never leaves, it so long as a particle of endosperm remains. Whatever ecdyses are necessary while the grub is feeding inside the corn all take place within the shelter of that corn, and, on breaking open an empty husk, it is usual to find one, two, or even three empty larval skins.

Some idea of the appearance of a handful of malt attacked by the grubs of *T. khapra*, as compared with an undamaged sample, may be formed from the photograph, Fig. *D*, Pl. 3. In the infected sample the corns have the appearance of being quite sound, but, on squeezing them between the fingers, they are found to be hollow and contain nothing but larval skins, hairs and faecal *débris*. The two tubes shown in Figs. *A* and *B*, Pl. 3, each contain the same weight of malt: *A*, representing 20 grams of normal malt, and *B*, 20 grams collected from a badly-infected bin. The material in *B* consists of nothing but empty husks, and it will be seen that the ratio of volume to weight indicates a loss of something like 50 per cent., which means that from the brewing point of view, the material is absolutely worthless.

No observations on the length of time occupied by the larval stage of *T. khapra* under English conditions have so far been possible, as the first consideration had regard to the extermination

of the pest. In India the larval period is variable. In the hot months, the whole life-cycle occupies, for males, only 25 days; for females, 35 days; while in the rainy season, the period in each case is extended to another five to seven days. From September to April, however, conditions appear to be inhibitive to development, and the grub remains in a condition of partial or complete hibernation. In England it is probable that the vicinity of a malt kiln, in which enormous numbers of this beetle have been found, presents ideal conditions for the shorter period of development; and under the storage conditions of a brewery the hibernating period would be more likely to obtain. It is a fact that in samples of infected malt from a brewery, the larvæ were in great preponderance, whereas, in samples from the hot-air chambers of a malthouse, the adult beetles were at least as numerous as the larvæ. It is also in the larval condition, in this country at any rate, that infection is likely to be spread. As already mentioned, the grub is covered with hairs which would readily form a means of anchorage to the clothing of workmen, who, in walking from the maltings to the brewery, would act as a means of distribution; for the same reason many of the grubs contained in a sack of infected material would be retained in the meshes of the fabric and there hibernate until the sack is refilled—perhaps in some other locality—when they would again become active and thus continue to spread infection.

Following the larval stage, the insect enters upon the pupal or resting period, during which, maturation of the perfect beetle proceeds. Pupation takes place in the last larval skin, which splits but is not actually cast off. The pupa is readily detected projecting from the larval skin and may be found lying among the insect *débris*. Frequently, however, in the case of malt the

pupa is found inside the husk, along with previously cast skins, indicating that the grub has passed its final stages in the interior of the corn and has there pupated: in due course there emerges the adult beetle, which escapes from the corn through the aperture made by the grub on its entrance. Dead beetles are rarely found inside the hollow corns, and when, as sometimes happens, a beetle is observed protruding through the husk, it is in all probability a newly-emerged insect making its exit, ready to continue the perpetuity of its species.

With regards to methods of eradication, *T. khapra* appears to possess quite extraordinary powers of endurance under all kinds of adverse circumstances. Barnes and Grove, in the course of their researches, carried out a large number of experiments with asphyxiating agents, including carbon dioxide, hydrogen and nitrogen, and the effects of these gases were tested on weevils and other beetle pests for comparison with *T. khapra*. Details of these experiments cannot be given, but it is significant of the difficulties to be encountered in attempting the extermination of the pest, to point out, that, in every case, *T. khapra* proved by far the most resistant insect.

Although for many years carbon dioxide had been believed to possess powerful insecticidal properties, and had been widely recommended for remedial purposes on this account, Barnes and Grove were forced to the conclusion that this gas could not be used economically as an asphyxiating agent against the larvæ of *T. khapra* "owing to their ability to enter upon a hibernating stage when atmospheric oxygen fails them," and to continue living by a process of respiration which is the result of enzymic activity. Moreover, in experiments on wheat it was demonstrated that carbon dioxide is inimical to the vitality of the seed, thus

confirming an opinion previously expressed by Badcock, and from which it follows that there are very serious objections to the use of this gas in any case involving ungerminated grain.

In the case of the brewery infection, it was found that some eighteen months previous to the matter being brought to our notice attempts had been made to eradicate the so-called weevil by washing down the bins with "Weevil Soap," by limewashing, and by burning sulphur, without these methods having the slightest beneficial effect. Nine bins, each containing 650 quarters (*qr.*=336 *lbs.*) of malt, were completely infested with the pest, and on screening the material five sacks were filled with larvæ and larval *débris* alone. This, obviously, was a state of things calling for immediate offensive operations, and allowing no time for extensive experiments. Inert gases, as shown above, were useless. Carbon disulphide is recommended by the Board of Agriculture as a remedy for Weevil, and it might prove deadly to *T. khapra*. Benzol, a readily volatilisable liquid, is extraordinarily efficacious against all kinds of insects, according to the writer's own experience, but both these substances have the very serious disadvantage of being highly inflammable, and their use in large quantities becomes a risk, which, in our opinion, should be avoided if at all possible.

A long experimental and practical experience with the use of antiseptics and detergents containing active chlorine, such as "Hypochloros" and other hypochlorite solutions, led us to believe that in the use of an irritant gas like chlorine lay the best means of attack. Preliminary experiments were conducted in which the larvæ of *T. khapra* were submitted to atmospheres containing various volume-percentages of gaseous chlorine. Without going into the details of an experiment, necessarily designed for

expediency rather than for quantitative accuracy, it was found that the grubs suffered appreciably from the effects of chlorine at so great a dilution as 0.2% by volume, and satisfactory evidence was obtained in favour of the use of this gas for the purpose of eradication.

The actual method of attack decided upon included fumigation with chlorine gas, using liquid chlorine as a source, and treatment of the walls, floors, etc., with a hypochlorite solution containing 15% available chlorine. The latter was applied by means of spraying apparatus, which ensured penetration of the liquid into all cracks and interstices likely to harbour the grubs, after which the rooms were sealed for a whole week.

The treatment outlined above proved perfectly successful. It need hardly be pointed out, however, that such a method of extermination must necessarily be carried out under the supervision of a technical chemist, and in the present instance the work was performed by members of our own staff.

For assistance in the identification of the beetle, *T. khapra*, we are indebted to Mr. E. C. Horrell (of Leeds) and Mr. G. C. Champion.

A preliminary notice of the occurrence of this pest will be found in "The Brewing Trade Review," December 1st, 1920.

F. A. M.

Oct. 15th, 1920.

An Investigation of The Causes of "Run" Pelts in the Sweating Process

FOR the benefit of readers not engaged in leather manufacture the following notes are prefaced by a brief outline of the method of removal of wool from skins by the sweating process. In preparing the skins for tannage, it is necessary to remove the hair or wool, together with the epidermis and a certain amount of fat. One of either of the two processes, liming or sweating, is employed to attain this object, and it is the latter process which is considered here in connection with the de-woolling of sheepskins.

The epidermis consists of a layer of cells of a keratinous nature which covers the whole grain surface, and forms a lining of the hair follicles. The collagen composing the true skin is not readily dissolved by acids or alkalies, but is merely swollen by them, whereas the keratin of the epidermis is dissolved by weak alkalies; thus, when this action is allowed to take place on the raw skin, consequent loosening of the wool or hair results.

Advantage is taken of the ammonia formed in putrefaction: by allowing the skins to remain under conditions favourable to the

growth of putrefactive bacteria for a comparatively short time, sufficient ammonia is produced to loosen the epidermis to such an extent that the wool may be easily removed by pulling.

The operation is carried out in rooms so constructed as to permit of control of ventilation and temperature, and wooden beams are placed at a convenient height in order that skins may be hung from them. The skins, in a wet condition, are suspended by their flanks from tenter-hooks in the beams, and the temperature of the chamber raised by means of steam to 60-75° F. After some time (60-80 hours) the wool on a number of skins is found to be easily removable, and these are then passed to men engaged in "pulling." The remainder require frequent examination so that they may not remain longer in the sweating chamber than is necessary for the disintegration of the epidermis.

Treatment previous to sweating consists of soaking and washing, and after sweating, the pelts require a short liming in order to swell them and remove fats by saponification. The principles and methods of sweating have been fully dealt with by competent authorities, and the reader is referred to the works of Prof. Procter, Mr. J. T. Wood, Mr. Seymour-Jones and others, for more detailed information.

The process of sweating is probably one of the oldest industrial methods still in use, and although it is not so extensively practised at the present time as it was formerly, a considerable number of fellmongers do remove the wool by sweating, and it is felt that any endeavour to establish a further means of control of this process is justified. Both the tanner and the textile manufacturer depend so largely for a high quality of their finished goods upon the fellmonger, that progress in the technical methods of fellmongering is of vital importance.

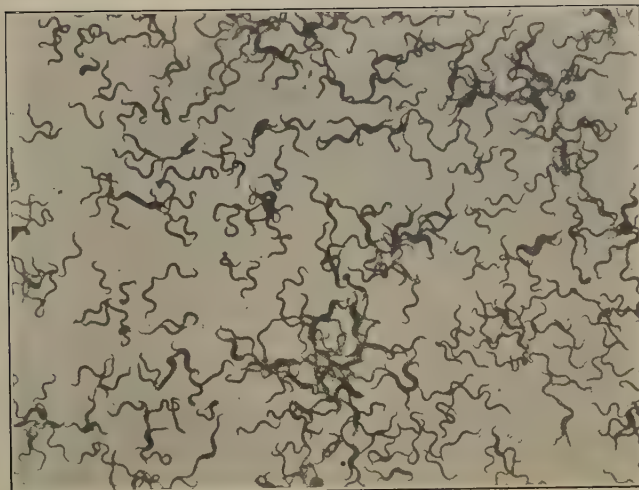


FIG. 1.



FIG. 2.

Plate 4.

Fig. 1. Nematode larvæ ($\times 20$).

Fig. 2. "Run" pelt, showing holes and pitting
in sheepskin grain, nat. size.

Wool removed by sweating has the greatest value to the textile manufacturer, and, since this process is unquestionably the cheaper form of de-woolling, there is much to be said in favour of its application; from the point of view of conservation of the skins, however, it does not at present compare favourably with the liming process. If the abnormal loss of hide substance which occurs in sweating were avoided, the factor which contributes towards this shortcoming would be eliminated.

Such an essentially biological process as the removal of the wool or hair from skins by partial putrefaction (sweating, staling, stoving) must inevitably be attended by conditions of a more or less offensive nature.

Although, to a certain degree, these conditions must prevail, there are many ways in which the adoption of sanitary and hygienic principles in fellmongering would be a distinct advancement. The impression that the sweating rooms need little attention from the point of view of cleansing is erroneous. On the contrary, accumulations of putrescible material there, or in any other part of the works, should be regarded as distributing centres of injurious moulds, bacteria, mites, and insect larvæ which are transported by flies, beetles, mice, etc., to the skins with deleterious effect, at various stages of their treatment. As a case in point, mention may be made of a fellmongery visited, in which the "glue pile" was some twelve feet high with the accumulation of putrid fleshings and "run" pelts. Apart from the fact that this was a menace to the health of the workpeople, and to the quality of the goods passing through the works, the amount of glue wasted represented a very considerable financial loss.

On leaving the soaks the skins have sufficiently large numbers of bacteria upon them to produce the effect of hair-slipping, and to expose them to further infection in the sweating rooms is to incur unnecessary risk of damage.

The form of damage known as "run" pelts appears to demand first attention, and the results of investigations and enquiries, made in several fellmongeries, are put forward with a view to suggesting means for the eradication of that trouble. The damage occurs as circular or oval pitted markings, found after sweating, usually upon the flesh side of the skin, but also frequently upon the grain. Examination of the pitted skin reveals the presence of a species of nematode, and experiments appear to prove that this organism is responsible for the localised breaking down of the hide substance which results in pitting.

The *Nematoda* belong to the family *Nemathelminthes*, and may be described as attenuated, unsegmented organisms of worm-like character. There appears to be very little information regarding either the classification or the life-history of the innumerable species which exist. Of known species the following may be mentioned: *Trichina spiralis*, which is responsible for "trichinosed" pork; *Tylenchus devastatrix*, which is parasitic upon, and causes much damage to cultivated plants; *Tylenchus tritici*, which produces galls in wheat; *Rhabdonema intestinale*, parasitic in man. More or less nearly related may be mentioned the different thread-worms, parasitic in man, rodents and domestic animals.

In practically all putrefying material, either animal or vegetable in origin, nematoda similar to the species under consideration may be found, and they have been isolated in the course of these experiments from decaying vegetables, rotten wood, dung, lined hair from sole-leather tannery, etc. In all cases the forms

studied were similar in size, and appeared to undergo a similar life-history to that of the species occurring during the sweating of skins. There is little doubt that the group of nematoda, to which this organism belongs, plays an important part in the natural disintegration of organic material, and that their elimination from the fellmongery is of economic importance.

Although certain species of nematoda are said to change their habitat during development from the larval to the sexually mature stage, the species under observation has been cultivated to the fourth generation in the same medium, each generation presenting the same characteristics.

The larvæ appear to undergo two ecdyses before becoming sexually mature, and until this point is reached no differentiation between male and female forms has been noted. When the adult larvæ have grown to a length of 0.5 mm. the skins are finally cast and the two sexes become apparent. In the case of the female, the vulva develops ventrally at the centre of the worm, and after two or three days, 50-60 eggs are seen to be developed, extending throughout the whole body cavity with the exception of the alimentary canal. The embryo is observed to be coiled in the interior of a membrane, which, on further growth, it breaks, living as a free larva in the ovary of the parent. Subsequently the larva emerges, and requires 9-12 days to reach the adult larval stage. The male is characterised by the possession of two spicules posteriorly placed, and is smaller in size (.9 mm.) than the female (1.25 mm.). Both sexes apparently die when their function of reproduction has been performed. Further investigation is necessary before definite anatomical data can be given, and the species determined. As the nematoda are credited with the property of withstanding desiccation for prolonged

periods, a number of dried skins of various origins (as occurring in the fellmongery) were soaked and efforts made to cultivate the organisms from them: in no case was this accomplished. On drying a medium containing the worm in various stages of development, and later resoaking, no living forms were found.

Upon all "run" pelts these nematode worms are found in large numbers, whilst upon the undamaged pelts, if found at all, they are exceedingly few in number, and, although no living forms were found in the soaking pits, a portion of wood from the ranges in a sweating room was found to be covered with organic matter containing the worm, which lived for two or three weeks without further nutriment.

The nematoda live upon organic juices, and require their nutriment to be in this condition; they possess tooth-like appendages at the mouth, but these are for the purpose of boring and disintegrating rather than for mastication. Sections cut from skin damaged by the worm demonstrate this; no worms are found to have individually penetrated into the skin fibres, but a depression has been made by their collective boring and movement. They are doubtless largely dependent upon the liquefactive bacteria for the reduction of the material to a partially digested state, but it is also suggested that they may themselves secrete a proteolytic enzyme. On a laboratory scale actual pitting could only be produced by commencing with skin rendered slightly alkaline with ammonia.

The conclusions so far arrived at are that the worms are not present in the skins when they are received at the fellmongery, but that they are actually being cultivated in the sweating chambers under optimum conditions. In support of the above statement the following incident is quoted: In a works badly



Plate 5.

- Fig. 1. Nematode larvæ, prior to ecdysis ($\times 150$).
Fig. 2. Male ($\times 130$).
Fig. 3. Female, showing later stages of development
of ova ($\times 130$).
Fig. 4. Female, showing evacuation of ova and
embryos ($\times 130$).

infected with the nematode a new sweating room was brought into operation, and the first batch of skins was not damaged ; subsequent batches became infected until, at the present time, similar numbers of skins are rejected from the new room as from the old ones. The nematode worms associated with putrefaction do not appear in considerable numbers until that process has reached a more or less advanced state, and they should not occur upon pelts otherwise than by infection from material in a more advanced state of decomposition.

When on an experimental scale, skin is incubated in a sterile vessel, in order to exclude all organisms other than those present in the first instance, a uniform slipping of the wool is produced, and if such a condition were aimed at, so far as is practicable, in the fellmongery, the number of pelts finding their way into the glue pile would be considerably reduced. There appears to be little doubt that this cause of "run " pelts would lend itself to a remedial treatment, and that the damage could be almost, if not entirely, eliminated.

Further investigations of the life-history of this nematode are in progress, and it is hoped that, at an early date, information will be forthcoming which will enable us to suggest preventative rather than remedial measures.

P. H.

Sept. 1st, 1920.

Notes from the Laboratories.

A STAIN-PRODUCING MOULD ON PIGSKIN.

Samples of English and Foreign Pigskins were received from a tannery for investigation with regard to the nature of certain reddish-brown stains which were damaging the skins. The stains were found to be effused over areas of several square inches, spreading from a somewhat darker centre. Microscopical examination showed the presence of large numbers of spores of a brown mould, a species of *Cladosporium*. Vertical sections of the skin were then examined and the presence of the mould in the bristle follicles and minute depressions of the grain was confirmed. The fungus was isolated and studied in pure culture: flawless samples of pigskin inoculated from this culture rapidly developed stains in all respects similar to those on the damaged skins. The fungus grows in both Pyrogallol and Catechol tan-liquors—using Quebracho and Valonia respectively—as well as in the detannised liquors, and on the hide powder after use in detannisation.

IRON STAINS ON SHEEP SKIN.

The pelt supplied for examination was stated to have been damaged by the action of bacteria, or other micro-organisms. A deep red discolouration occurred over a large area (Fig. 3). As cultural methods failed to demonstrate the presence of any organism capable of producing such a stain, a chemical investigation was carried out.

Microscopic analysis did not demonstrate the presence of iron, and the ordinary chemical tests were indefinite until the material had been ignited and dissolved. A quantitative determination of iron contained in the stained and unstained portions of the skin gave results as follows:—

Stained portion ...	...	0.21% Ferric Oxide.
Unstained portion...	...	0.06% " "

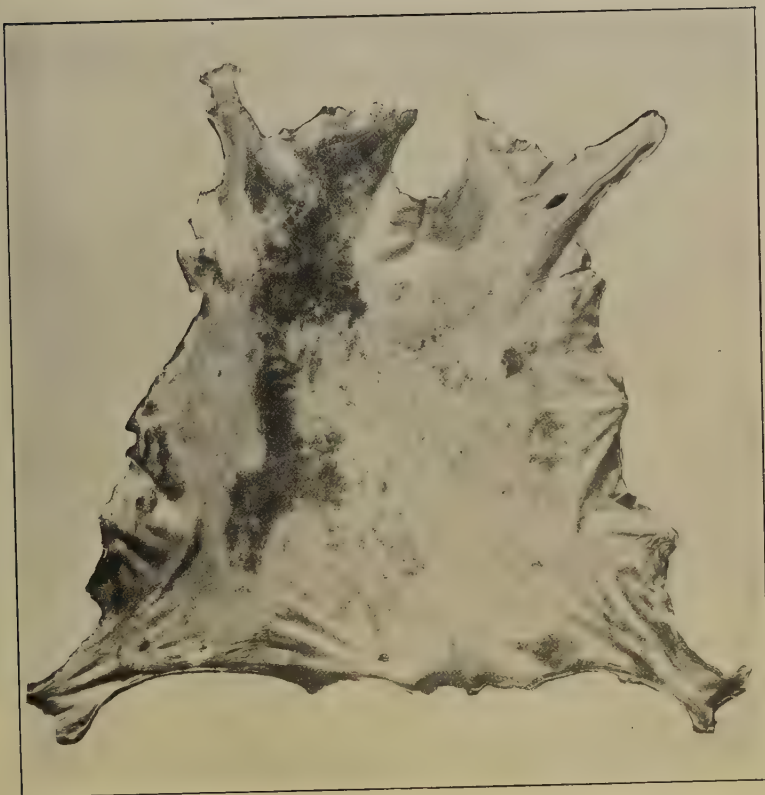


Photo. by Bureau of Bio-Technology

FIG. 3

PLANT PESTS.

Some cases reported upon since the last issue of the *Bulletin* include the following:—Vegetable marrows attacked by *Julus* worm, *Julus pulchellus*; turnips attacked by the Cabbage Root Fly, *Chortophila brassicæ* Bouch; celery badly infested with the Celery Fly, *Acidia heraclei* Linn; soil from tomato house, containing vast numbers of putrefying bacteria, *Euglena viridis* and many other motile infusoria, nematodes and fly larvæ. Tomato plants from the last-mentioned source badly infected with the Tomato Leaf Rust, *Cladosporium fulvum* Cke; lettuce suffering from the ravages of White Lettuce Mould, *Bremia lactuæ* Regel; grapes destroyed by the fungus, *Sclerotinia Fuckeliana*.

GRAIN PESTS.

Samples of malt examined from various sources have been found to contain the following beetles:—The two weevils, *Calandra granaria* Linn, and *C. oryze* Linn; *Niptus hololeucus* F., *Ptinus tectus* B., and *Tribolium castaneum* Herbst. The weevils attack the grain by boring through the husk, and are responsible for much damage. We have not observed any serious damage that could be ascribed either to *N. hololeucus* or to *T. castaneum*. The latter insect, when found in malt, appears to confine its attacks to the corns already spoilt by mechanical injury and prefers the wheat grains and other foreign seeds not possessing so strong a protection as that afforded by the husk of a barley corn.

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